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By

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Personality Trait Patterns of College Students Majoring in Different Fields

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I. Introduction

Counselors of undergraduate college students frequently use batteries of psychological tests in helping students to select appropriate major fields of study. The task of interpreting scores on a battery of tests to students is not at any time a simple undertaking. The trend toward emphasis on the importance of the relationships among the various scores in a battery, i.e., the pattern of scores, has further complicated test interpretation.

One method of discovering and interpreting the pattern of scores made by an individual student is to isolate high and low scores on the test scales and then try to establish some logical order or constellation of scores, giving the pattern meaning according to the counselor's understanding of the significance of the different test scales.

This approach is an improvement over more atomistic methods of test interpretation, but it has some serious weaknesses. It is based on rather unstructured, subjective evaluations of the nature and extent of the interrelationships among scores on a given group of test scales. It is subject to fluctuations from one counselor to the next and from one application to another. The relationships established according to this method tend to be lacking in definiteness and are not easily verifiable statistically. Because of these limitations, there appears to be a need for a more systematic and dependable method of establishing relationships among test scores and of interpreting the patterns which are formed by those relationships.

Such an approach is made possible by the factor-analysis method, by which relationships among test scores may be ordered into patterns whose existence has been established by comparatively rigorous statistical procedures.

Another advantage of the factor-analysis method lies in the reduction in the number of interpretations which have to be made, because there are fewer, often far fewer, factor scores than there are test scores.

Finally, factor analysis may open the way for research whose outcome could be particularly useful to counselors, for

[1] This study is based on my doctoral dissertation (11). Many helping hands guided that document from its earliest planning stage through its final form. Among those helpers to whom my thanks go are Professor William D. Wilkins, chairman of my sponsoring committee, Professor Philip J. Zlatchin, and Professor R. Bernard Von Guerard, committee members.

I am particularly indebted to Mr. William H. Helme, of the Lenox Hill Advisory Service of New York, for his invaluable assistance in the design of the study and in the statistical treatment of the data.

The chief contributor to the dissertation was my wife, Shirley deBobes Sternberg, who gave much time to the thesis, including hundreds of hours on the assembling and statistical computation of the data, and also gave much-needed hope and encouragement to the author.

factor analysis makes possible studies of the relationship between *profiles* of scores and certain criteria, such as success in a particular field of study or work.

It is necessary, of course, to say here that the interpretation of a factor may also be "rather unstructured and subjective." However, factor analysis can establish fairly clearly the structure of a pattern, as well as the relative importance of its components. It is fairly simple to check on the accuracy with which the pattern is described in the factor analysis by repeating the original study. When the pattern is fairly well defined, subjective interpretations of it may differ to some extent, but are reasonably certain to contain a substantial core of common agreement about the meaning of the pattern.

Where less rigorous procedures are used to formulate patterns among test scores, the very existence of these patterns may be questioned, let alone the relative weights of the components of the pattern. Consequently, such procedures seem to offer far less in the way of clarifying the meaning of test-score patterns than does the factor-analysis method.

In the present study, the factor-analysis method is applied to the interpretation of test scores in some areas of personality measurement, where counselors often have particular difficulty in determining the relationships among scores on different tests or inventories of personality. A number of recent investigations (4, 9, 10, 13) have pointed up the importance of personality attributes in the selection of a career, a process in which the choice of a major field of study is often an integral part.

II. The Problem

The study sought the answer to two primary questions:

1. What are the patterns of scores *(factors)* made by college students on three measures of personality—an interest inventory, a values test, and an inventory of tendencies toward maladjustment?

2. Are there significant differences in personality patterns *(factor scores)* among students majoring in different fields of study?

III. The Study Population

The participants in the study were 270 white male college students, 30 of them majoring in each of the following subjects: Biochemistry (Premedical), Chemistry, Economics, English, History, Mathematics, Music, Political Science, and Psychology.[2] The students were drawn at random from the total male population majoring in each of the selected areas of specialization. The term "random sampling" might be something of a misnomer here, for the study population included at least 80 per cent of the total male population in each of the major fields of study. All participants in the study were volunteers.

The college where the students were in attendance is a metropolitan, nonresident, tax-supported, tuition-free liberal arts college. Entrance requirements of the college are very high. Entering freshmen scores on the American Council on Education Psychological Examination for College Freshmen are almost invariably in the top quartile of the national distribution (14, p. 16).

Attrition of students is approximately 40 per cent during the first two years of the students' college careers, when they

[2] The number of men in each group is admittedly small. It should be noted, however, that in order for differences between small groups to be significant, the differences must usually be quite large—which in turn usually implies differences of *practical*, as well as merely statistical, significance. (See Tables 7-11.)

follow a prescribed general education curriculum. This prescribed program consists of courses in English Composition and Literature, Foreign Language, Natural Sciences, Mathematics, Social Sciences, Speech, Art, and Music.

The students in this study had all completed the two-year prescribed program and were in their respective areas of specialization. The men were probably select in terms of academic ability. It appears to be reasonable to assume that these students had chosen areas of specialization where they had some assurance that they had enough ability to complete successfully their courses of study. They had all had the experience of completing basic courses in a wide variety of subject-matter fields, and we might assume that the observation made by Ginzberg and his associates would apply to the participants in this study: "We hold it a basic fact that an individual, at least a normal individual, cannot maintain an interest in an activity unless he is reasonably good at it" (5, p. 187).

Students who were known by the Medical Office or the Counseling Office of the college to have serious personality disorders for which treatment had been recomended were excluded from the study on the premise that their responses to test questions might not be reliable.

The students in the nine subgroups were similar in mean age, which ranged from 20 years, 5 months for the Psychology majors to 21 years, 4 months for the Economics majors.

Information derived from student personnel and other records at the college placed the median family income for the college as a whole at $5,700, with a range extending from below $1,500 to over $15,000 per annum. The income data were for the year 1951.

IV. Procedure and Results

The Kuder Preference Record, Form BM, the Allport-Vernon Study of Values, 1931 edition, and the MMPI, Group Form, were administered to the 270 men.

Correlations among the scores made on the 24 scales of the three tests were calculated by the Pearson product-moment method.[3] The matrix data were factor analyzed by the Thurstone centroid method and seven factors were extracted, six of them bipolar in structure.

A. *The Trait Patterns (Factors)*

The basic data of the factor analysis are presented in Tables 1 (the centroid factor matrix), 2 (the transformation matrix), and 3 (the rotated factor matrix). Factor loadings of $\pm.33$ or greater are italicized in Table 3 to indicate the variables which contribute significantly to a particular factor.

The interpretation of a factor is admittedly somewhat subjective, but may be valuable in facilitating communication of ideas about psychological traits (12, p. 145). It should be understood that the interpretations which follow are applicable to the population studied here, but may not be applicable to other populations from different socioeconomic and intellectual environments. It should also be understood that the composition of the factors might change if tests other than those used in this study were to be the measuring instruments.

In making the factor interpretations, the meanings given to the test scales are those supplied by the authors of the three tests in the respective test manuals (1, 6, 7), with the exception of the MMPI scales, where minor changes were made in some of the scale definitions after an analysis of the content of the items on each scale (11, pp. 146-148). The con-

[3] Raw score means and standard deviations for the total population ($N = 270$) and the subgroups ($N = 30$), and the correlation matrix data, have been deposited with the American Documentation Institute. Order Document No. 4598 from the ADI Auxiliary Publications Project, Photoduplication Service, Library of Congress, Washington 25, D.C., remitting in advance, $1.25 for microfilm or $1.25 for photocopies. Make checks payable to Chief, Photoduplication Service, Library of Congress.

TABLE 1

CENTROID FACTOR MATRIX*

Test Scales	Factors I′	II′	III′	IV′	V′	VI′	VII′	h**
Theoretical	−169	−212	363	−292	−405	−153	364	610
Economic	−425	−065	−285	358	190	−334	230	595
Aesthetic	583	108	593	381	080	145	137	895
Social	317	129	−061	−374	−290	−325	−182	484
Political	−320	195	−381	061	239	−181	−158	404
Religious	−057	−062	−168	−184	107	244	−458	350
Mechanical	−546	−385	234	−169	269	−192	−109	651
Computational	−550	−430	−084	227	−286	119	124	657
Scientific	−571	−443	314	−427	−068	−182	022	841
Persuasive	078	443	−525	108	289	−150	175	626
Artistic	299	−194	506	318	261	045	−189	590
Literary	431	244	−080	160	−267	−195	088	394
Musical	492	225	393	204	147	136	093	537
Social Service	166	348	−172	−604	−183	−133	−084	601
Clerical	−132	−182	−406	521	−194	274	126	715
Hypochondriasis	438	−496	−215	−285	189	100	270	684
Depression	526	−481	067	095	−186	−108	081	574
Hysteria	632	−389	−188	−224	235	194	210	773
Psychopathic Deviate	573	−269	−173	088	101	−213	−026	495
Masculinity-Femininity	632	050	145	099	−304	125	−085	542
Paranoia	495	−243	−089	041	−172	138	−212	407
Psychasthenia	571	−574	−116	091	−146	−129	−097	725
Schizophrenia	623	−485	−154	105	−083	−212	−105	721
Hypomania	241	073	−312	114	236	−183	−089	271

* Decimal points omitted.
** h = communalities.

tent analysis was made because the MMPI test scales did not appear to be as internally consistent as the scales on the other two tests.

The seven factors are described and interpreted below. Only variables with positive or negative loadings of .33 or higher are listed.

1. Factor I′: Aesthetic Communication vs. Practical Science

Positive Loadings		Negative Loadings	
Literary	.53	Scientific	.78
Masculinity-Femininity	.52	Mechanical	.69
Aesthetic	.51	Computational	.52
Musical	.51	Economic	.44
		Theoretical	.40

The positive pole of Factor I′ might be symbolized by a person with a dominant interest in what might be termed "aesthetic communication."[4] He might be individualistic, imaginative, given to idiosyncratic behavior, antimaterialistic in his values, averse to the use of scientific approaches in his thinking, and interested in reaching out to people, but more on the ideational than on the interpersonal level.

At the negative pole, we might find a practical, concrete, logical person who has a strong interest in the how and why of the tangible objects and processes of his environment. He would probably not be much attracted by work which would bring him into frequent direct contact with other people, and his interest in communicating with other people would tend toward more formal means than those which might characterize the positive pole of Factor I′. He would be

[4] Note in Table 3 that the Persuasive loading is close to significance. The communication element is large on this scale, as well as on the Literary, and to a lesser extent, the Musical scales.

TABLE 2

TRANSFORMATION MATRIX*

Factor	I	II	III	IV	V	VI	VII
I′	678	523	−076	115	021	491	−083
II′	−494	584	−260	−116	447	088	355
III′	132	096	671	489	379	−266	264
IV′	183	044	−628	488	131	−541	−148
V′	359	−530	−240	−219	482	144	482
VI′	−320	−270	−139	669	−113	576	117
VII′	121	143	−072	029	−628	−187	728

* Decimal points omitted.

disposed to conform to the mores and conventions of society, not because he was particularly submissive to authority, but rather because he did not feel constrained or hampered by societal rules and regulations. He would probably tend not to be much interested in either changing rules or in disobeying them. The concrete, readily measurable, more controlled activities of the scientific-technical world would attract him much more than would the less predictable, relatively indefinite aesthetic pursuits.

Factor I′, then, is designated as *Aesthetic Communication vs. Practical Science.*

2. Factor II′: The Go-getter vs. the Passive Aesthete

Positive Loadings		Negative Loadings	
Persuasive	.52	Psychasthenia	.71
Political	.42	Schizophrenia	.66
Economic	.40	Depression	.63
		Paranoia	.51
		Masculinity-Femininity	.48
		Psychopathic Deviate	.39
		Artistic	.38
		Aesthetic	.38

The second factor lacks the clarity of the first factor. Factor II′, at the positive pole, seems to represent preference for promotional activities as they relate to the attainment of influence and prestige in the business world. A typical Factor II′ positive might be pragmatic, relatively well adjusted to the world in which he moved, interested in contact with people, not for the purpose of satisfying his needs for interpersonal relationships, but rather because people represented the source of his prestige and material enhancement. The descriptive phrase "go-getter" comes readily to mind here.

The opposite pole of Factor II′ is weighted with indicators of tendencies toward maladjustment, which are linked with aesthetic preferences, principally of an artistic nature. In a supposedly normal population, the constellation of traits making up the negative side of Factor II′ suggests a person who seeks to mediate his personal difficulties through aesthetic interests or activities. The absence of a significant communication element might be taken to mean that the artistic preferences present here tend to be passive in nature.

Factor II′ may be summed up in the label: *"The Go-getter vs. the Passive Aesthete."*

3. Factor III′: Self-Expression Through Art vs. Faith Through Good Works

Positive Loadings		Negative Loadings	
Aesthetic	.70	Social Service	.41
Artistic	.55	Religious	.36
Musical	.50		

The man who preferred the individualistic activities of the creative artist to the "other-oriented" work of the spiritu-

TABLE 3
ROTATED FACTOR MATRIX*

Test Scales	Factors I′	II′	III′	IV′	V′	VI′	VII′
Theoretical	*−401*	−166	041	*−433*	−014	−133	*464*
Economic	*−438*	*342*	144	*444*	027	247	081
Aesthetic	*512*	*−325*	*698*	−162	053	046	077
Social	093	−241	−242	085	−132	*−553*	160
Political	−150	*399*	−152	*371*	−127	−006	−213
Religious	081	−021	*−363*	−048	−041	009	*−456*
Mechanical	*−687*	069	089	−192	038	−020	*−355*
Computational	*−524*	−058	−166	−075	−060	*571*	129
Scientific	*−784*	−046	−087	*−443*	−059	−120	−073
Persuasive	254	*521*	−051	*508*	096	−102	087
Artistic	143	*−376*	*552*	−079	060	073	*−328*
Literary	*527*	−140	−026	065	−049	076	294
Musical	*506*	−128	*496*	−115	054	−065	021
Social Service	181	114	*−411*	−081	−098	*−502*	143
Clerical	027	−013	−164	284	−058	*690*	162
Hypochondriasis	051	−228	−157	−015	*769*	−097	048
Depression	046	*−632*	094	101	*340*	−016	189
Hysteria	296	−267	−097	003	*769*	−111	−002
Psychopathic Deviate	169	*−388*	065	*376*	*377*	−164	003
Masculinity-Femininity	*517*	*−483*	067	−019	−021	−074	176
Paranoia	303	*−508*	−156	089	154	020	−040
Psychasthenia	048	*−708*	−061	*262*	*381*	−020	043
Schizophrenia	095	*−655*	−020	*360*	*373*	−102	036
Hypomania	160	049	000	*442*	143	−120	−115

* Decimal points omitted; figures in italics indicate variables which contribute significantly to a particular factor.

ally motivated welfare worker would typify the positive side of Factor III′. The absence of significant loadings for the MMPI scales on the positive side of the factor suggests that the preferences there might arise not from hostility toward people or fear of them, but rather from the tendency to derive major personal satisfaction, possibly even spiritual sustenance, from artistic or other creative activities in the aesthetic areas.

"Faith through good works" exemplifies the man with a Factor III′ pattern at the negative pole. He would tend to prefer activities in which the dominant motive would be to help other people. He might seek such work in a religious setting, or might pursue it in a nonsectarian work environment as the result of religious feelings or convictions. The activities of the other side of the factor would be rejected because they appeared to be self-centered and lacking in altruism.

The phrase *"Self-Expression Through Art vs. Faith Through Good Works"* might characterize Factor III′.

4. Factor IV′: The Driven Extravert vs. the Pure Scientist

Positive Loadings		Negative Loadings	
Persuasive	.51	Scientific	.44
Economic	.44	Theoretical	.43
Hypomania	.44		
Political	.37		
Psychopathic Deviate	.37		
Schizophrenia	.36		

The pattern of traits on the positive side of Factor IV′ might be labeled "the Driven Extravert" and might be personified by a Willy Loman of the play *Death of a Salesman*. Such a man would be sporadically energetic, materialistic, overexpansive, overtly gregarious but inwardly not at ease with people. He would

be a person whose potentially beneficial drive toward contact with people tended to get out of hand somewhat and to push him toward behavior which was overactive, maladaptive, and even bizarre.

The controlled, precise, and rather depersonalized activities of the research scientist, who might represent the negative side of Factor IV′, would appear to be lacking in excitement and much too far removed from frequent contact with large numbers of people to have any real attraction for the Willy Lomans.

Conversely, the uncontrolled reaching out to people which appears to characterize the man at the positive pole of the factor would seem immature, undignified, and somewhat repulsive to the "pure scientist."

The essential elements in Factor IV′ may be summarized in the dichotomy: *The Driven Extravert vs. the Pure Scientist.*

5. Factor V′: Preoccupation with Health

Positive Loadings	
Hypochondriasis	.77
Hysteria	.77
Psychasthenia	.38
Psychopathic Deviate	.38
Schizophrenia	.37
Depression	.34

The major theme of Factor V′ appears to be preoccupation with health and bodily functioning. The two scales with the heaviest loadings on this factor contain many items dealing with health and health problems (11, pp. 147-148), and the remaining scales have some items in the same areas.

Another reason for the composition of the factor may be the overlapping of items on the scales of the MMPI test. There is a high degree of positive correlation among many of the test scales (11, p. 129), which implies that, to some extent, the same characteristics are being measured by different scales.

6. Factor VI′: Quantitative Detail vs. Social Welfare

Positive Loadings		Negative Loadings	
Clerical	.69	Social Service	.59
Computational	.57	Social	.55

This factor contrasts preference for detailed work, mostly with numbers or numerical relationships, with interest in working with people in "welfare work."

On the positive side of the factor, we would have a prosaic, factual, and somewhat detached individual whose needs could best be satisfied by tasks that were impersonal in nature and required precision, accuracy, and attention to detail. The complexity and stresses of work requiring frequent personal contact with troubled people would be felt as anxiety-provoking, consequently as situations better to be avoided than to be experienced.

The activities on the other side of the factor would tend to attract the person whose individual concerns could be worked out through social welfare activities, that is, through involvement in other people's problems. Participation in movements to promote social legislation, activity in community welfare organizations, or even professional employment in a social work agency are among the possible means by which one could satisfy the needs suggested by the negative side of Factor VI′. The activities represented by the other side of the factor would be too dry and too distant from people for the man whose test scores would show a negative Factor VI′ pattern.

7. Factor VII′

Positive Loading		Negative Loadings	
Theoretical	.46	Religious	.46
		Mechanical	.36
		Artistic	.33

The seventh factor is so poorly articu-

lated that it seems pointless to assign a label or descriptive phrase to it. There may be a hint of a contrast between logical, scientific attitudes or modes of thought and mystical attitudes or ways of thinking. However, it is difficult to fit the Mechanical and Artistic scales together with the Religious scale in any plausible manner. One possible meaning is suggested (among many other equally weak or remote meanings), that is, that the negative side may represent an approach to religious expression by way of craft media (ceramics, wood carvings, etc.).

Because Factor VII′ is obscure in meaning and has few significant loadings, it will not be included in the analysis of intergroup differences in factor scores.

B. *Intergroup Differences in Trait Patterns (Factor Scores)*

As a preliminary step to the comparison of the nine subgroups on mean factor scores, multiple regression equations were devised to convert raw scores into factor scores.

Raw scores were first converted into standard scores. Beta weights (standard partial regression coefficients) were derived by the Doolittle method. It was required that the variables used to predict factor scores from raw scores meet at least one of the following two criteria:

1. Moderate or high correlation (equal to or greater than .35) with the factor and low correlations with the other variables highly loaded with the same factor.

2. When the first criterion did not yield a multiple correlation of at least .80 with the factor, suppressant variables were introduced. These had low loadings with the factor, but high correlations with the highly loaded variables.

The variables selected are shown in Table 4.

After standard partial regression coefficients and coefficients of multiple correlation were calculated, "facilitating tables" were constructed. These tables showed the factor-score equivalents for raw scores of each variable or test scale which contributed significantly to the prediction of scores on each of the six factors. To calculate the contribution of a raw score to a factor score the following formula was used:

$Z_A\beta_{1A}/R^2$ = contribution to factor score from raw score on variable A

Z_A represents the standard score equivalent of a raw score on variable A, β_{1A} the beta weight of the predicting variable, and R the coefficient of multiple correlation. The zero point for each variable was set at the mean raw score for the variable ($N = 270$). All possible raw scores were listed in terms of standard scores at intervals of .04. Appendix A shows a sample facilitating table (in this instance for Factor I′).

Following the construction of the facilitating tables, conversion sheets were made up, as in Appendix B. Down the extreme left-hand side of the sheet are found the scale names and the scores made on each scale by a particular student. Next right are six columns, one for each factor. In the appropriate rows and columns are entered the factor score equivalents of the raw scores on the scales contributing to each of the six factors. Each factor column is summed algebraically and the sum is then entered at the upper right of the conversion sheet, to the right of the appropriate factor number.

This procedure was followed for each of the 270 men. Means and standard deviations of factor scores were calculated for the total population and for each of the nine subgroups. Table 5 gives these data.

Differences significant at or beyond the 5 per cent level of confidence were found among the total population on all factors except V′, which was then elimi-

TABLE 4

VARIABLES USED TO PREDICT FACTOR SCORES FROM RAW SCORES

Variable	Factor I′ β_{ik}*	γ_{ik}**	$\beta_{ik}\gamma_{ik}$
Scientific	−.504	−.784	.3951
Economic	−.329	−.438	.1431
Mechanical	−.201	−.687	.1381
Musical	.121	.506	.0612
Theoretical	−.126	−.401	.0505
Literary	.058	.527	.0306
		R^2 = .8187	
		R = .905	

Variable	Factor II′ β_{ik}	γ_{ik}	$\beta_{ik}\gamma_{ik}$
Persuasive	.378	.521	.2074
Schizophremic	−.252	−.655	.1716
Psychasthenic	−.231	−.708	.1621
Depression	−.144	−.632	.0967
Masc.-Femininity	−.144	−.483	.0734
Paranoia	−.137	−.508	.0696
		R^2 = .7808	
		R = .884	

Variable	Factor III′ β_{ik}	γ_{ik}	$\beta_{ik}\gamma_{ik}$
Aesthetic	.534	.698	.3727
Social Service	−.304	−.411	.1249
Artistic	.134	.552	.0740
Musical	.114	.496	.0565
Paranoia	−.281	−.156	.0439
Clerical	−.149	−.164	.0245
		R^2 = .6965	
		R = .835	

Variable	Factor IV′ β_{ik}	γ_{ik}	$\beta_{ik}\gamma_{ik}$
Economic	.418	.444	.1856
Schizophrenia	.390	.360	.1404
Persuasive	.260	.508	.1321
Theoretical	−.205	−.433	.0888
Hypomania	.177	.442	.0782
Mechanical	−.087	−.192	.0176
		R^2 = .6418	
		R = .801	

Variable	Factor V′ β_{ik}	γ_{ik}	$\beta_{ik}\gamma_{ik}$
Hysteria	.576	.769	.4429
Hypochondriasis	.402	.769	.3091
Social	−.175	−.132	.0221
Masc.-Femininity	−.200	−.021	.0042
Economic	.105	.027	.0028
		R^2 = .7811	
		R = .884	

Variable	Factor VI′ β_{ik}	γ_{ik}	$\beta_{ik}\gamma_{ik}$
Clerical	.401	.690	.2767
Social	−.296	−.553	.1637
Computational	.273	.571	.1559
Social Service	−.210	−.502	.1343
Theoretical	−.106	−.133	.0141
Psychopath. Deviate	−.081	−.164	.0133
		R^2 = .7480	
		R = .865	

* Beta weights.
** Final factor loadings.

TABLE 5

MEANS AND STANDARD DEVIATIONS OF FACTOR SCORES* ON SUBGROUPS

Subgroup	Factor I′		Factor II′		Factor III′		Factor IV′		Factor V′		Factor VI′	
	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*
Biochemistry	−.912	.778	.348	1.039	−.384	.914	−.944	1.590	−.204	.978	−.684	.843
Chemistry	−1.089	.861	−.398	1.119	.044	.987	−.859	1.402	−.020	1.107	.305	.948
Economics	−.137	.937	.372	1.180	−.341	1.127	1.164	1.522	−.042	1.161	.616	1.404
English	1.353	.608	−.674	1.039	.768	.852	.418	.854	−.012	1.231	−.098	1.057
History	.451	.812	−.880	1.016	−.617	1.225	.289	1.304	−.196	1.309	−.143	.966
Mathematics	−.916	1.034	.944	.956	−.145	1.025	−.924	1.267	.107	1.062	.916	1.053
Music	.734	.783	−.305	.909	1.530	.797	−.132	1.066	.173	1.227	−.393	1.045
Pol. Science	.689	.806	.336	1.029	−.494	1.066	1.077	1.270	.189	1.013	.104	.893
Psychology	−.334	1.063	.479	.945	−.360	1.079	−.145	1.395	−.104	1.038	−.664	.965
Total (N = 276)	−.005	1.187	.000	1.088	.011	1.212	−.005	1.251	.001	1.140	.005	1.155

* Standard scores.

nated from further consideration in the study. The analysis of variance data are given in Table 6. Significant differences in mean factor scores on the five remaining factors were calculated by *t* tests. The method used to calculate *t* was that suggested by Lindquist (8, p. 97), where the significance of differences between means is to be computed among a number of subgroups, each based on the same *N*. The following procedure was used:

1. Obtain the standard error of the mean by dividing the variance within groups by the number of cases on which the mean was based and then extracting the square root of the result. Where standard scores are being used, the assumption is made that each subgroup has approximately the same standard deviation and consequently the same standard error of the mean.[5]

2. Compute the standard error of the difference between two means by the formula $\sigma_{M_X-M_Y} = \sqrt{\sigma^2_{M_X} + \sigma^2_{M_Y}}$, where σ_M is the standard error of the mean. Since σ_M is the same for each subgroup, the formula may be written thus: $\sigma_{M_X-M_Y} = \sqrt{2\sigma^2_M} = \sigma_M\sqrt{2}$. It should be noted that the standard error of the difference between two means, being based on the variance within groups (nine groups of 30 men each), involved 261 degrees of freedom.

3. Compute *t* by the formula: $t = \frac{M_X - M_Y}{\sigma_{M_X-M_Y}}$

The *t*-test results are presented in a form which is different from the usual form of presentation. The form was chosen to make it easier to identify significant differences between subgroup means. The tables were constructed in the following manner: First, the *t* values for the .001 and .01 levels of confidence were listed. Then, by the formula for *t* (see step 3, above), the minimum differences between means significant at the .001 and .01 levels of confidence were computed. The procedure may be illustrated by reference to Table 7. There the standard error of the difference between two means is given as .226. The value of *t*, for 261 *df* at the .001 level, is 3.29. The formula for *t* may be manipulated

TABLE 6

ANALYSIS OF VARIANCE, FACTORS I′–VI′

Factor	Source of Variation	Variance	*F* ratio
I′	Between groups	22.42	29.11**
	Within groups	.77	
II′	Between groups	4.20	3.82*
	Within groups	1.10	
III′	Between groups	14.69	13.73**
	Within groups	1.07	
IV′	Between groups	19.80	11.06**
	Within groups	1.79	
V′	Between groups	.57	.43
	Within groups	1.33	
VI′	Between groups	9.16	8.33**
	Within groups	1.10	

* Significant at .05 level of confidence.
** Significant at .01 level of confidence.
Note.—Degrees of freedom "between groups" = 8, "within groups" = 261.

[5] Table 5 shows that there is some variation in *SD* among the subgroups on each factor. However, when the usual method was used to calculate *t values*, it was discovered that Lindquist's method gave more conservative results. The standard error of the difference between two means computed by Lindquist's method was consistently larger than that computed by the usual method. This meant that the *t*'s derived by the process used here were consistently smaller than those obtained by the other method (see the formula for *t* in step 3 of the procedure given above). For example, on Factor I′ (Table 7), the orthodox method gave *t*'s of approximately 12 between English and Biochemistry and 5 between English and History, where Lindquist's method gave *t*'s of 10 and 4, respectively. Samplings taken among all the remaining factors gave similar results. Although some minor changes in the findings would have resulted from use of the usual method for deriving the standard error of the mean, the standard error of the difference between two means, and the *t* values, the changes would not be large enough to affect the interpretations of the differences between subgroups. Lindquist's method was used because the variance within groups had already been computed and *t* values could be computed most quickly by this method. Another reason for retaining Lindquist's method was that conservative methods seemed preferable when subgroups with an *N* of 30 were being studied.

TABLE 7

SIGNIFICANT DIFFERENCES BETWEEN SUBGROUP MEAN SCORES ON FACTOR I′

Engl.	(1.35) − Chem.	(−1.09) = 2.44	
Engl.	(1.35) − Math.	(−.92) = 2.27	
Engl.	(1.35) − Biochem.	(−.91) = 2.26	
Engl.	(1.35) − Psych.	(−.23) = 1.58	
Engl.	(1.35) − Econ.	(−.14) = 1.49	
Engl.	(1.35) − Hist.	(.45) = .90	
Music	(.73) − Chem.	(−1.09) = 1.82	
Music	(.73) − Math.	(−.92) = 1.65	
Music	(.73) − Biochem.	(−.91) = 1.64	
Music	(.73) − Psych.	(−.23) = .96	
Music	(.73) − Econ.	(−.14) = .87	
Pol. Sci.	(.69) − Chem.	(−1.09) = 1.78	
Pol. Sci.	(.69) − Math.	(−.92) = 1.61	
Pol. Sci.	(.69) − Biochem.	(−.91) = 1.60	
Pol. Sci.	(.69) − Psych.	(−.23) = .92	
Pol. Sci.	(.69) − Econ.	(−.14) = .83	
Hist.	(.45) − Chem.	(−1.09) = 1.54	
Hist.	(.45) − Math.	(−.92) = 1.37	
Hist.	(.45) − Biochem.	(−.91) = 1.36	
Econ.	(−.14) − Chem.	(−1.09) = .95	
Econ.	(−.14) − Math.	(−.92) = .78	
Econ.	(−.14) − Biochem.	(−.91) = .77	
Psych.	(−.23) − Chem.	(−1.09) = .86	
Hist.	(.45) − Psych.	(−.23) = .68	
Hist.	(.45) − Econ.	(−.14) = .59	
Psych.	(−.23) − Math.	(−.92) = .69	
Psych.	(−.23) − Biochem.	(−.91) = .68	
Engl.	(1.35) − Pol. Sci.	(.69) = .66	
Engl.	(1.35) − Music	(.73) = .62	

Note.—Numbers in parentheses are subgroup mean scores. $\sigma_{M_x-M_y}$ (standard error of the difference between two means) = .226. Difference significant at .001 level = .74; difference significant at .01 level = .59.

thus: $t = \dfrac{M_x - M_y}{\sigma M_x - M_y}$, or $3.29 = \dfrac{M_x - M_y}{\sigma M_x - M_y}$, or $M_x - M_y = 3.29(\sigma M_x - M_y)$. Then the minimum difference between means which is significant at or beyond the .001 level is 3.29 times .229, or .74, the figure which appears in the upper right of Table 7. The figure for the .01 level of confidence was derived in the same manner.

Tables 7–11 show the significant differences between the subgroups in mean scores on the five factors where the *F* ratio was significant at or beyond the 5 per cent level of confidence. A description of the differences between subgroups and an interpretation of the differences on each factor appear below.

1. *Factor I′.* The position of the subgroups on Factor I′ appears to follow what might be called a "logical order." Where the dominant preferences are for communication or verbalization in aesthetic areas and where there is disinterest in scientific-technical activities of a practical nature, it is not surprising to find the students distributed as they are on Factor I′ in Table 7.

Neither the high scores of the English and Music students nor the low scores of the science students seem to require much explanation. Among the social science subgroups, the division on this factor may be best explained by the probable attitudes of the three subgroups toward aesthetic activities. It is probable that the Economics students are more business-minded or more materialistic in outlook than are the History or Political Science students. Consequently, the men majoring in Economics may see aesthetic activities or attitudes as unrealistic or impractical, therefore as uninteresting to them. The position of the Economics students on Factor I′ comes more from an aversion to aesthetic activities than from a preference for scientific ones. It is also possible that the greater applicability of scientific-technical activities to "practical" situations may account for their relatively greater attraction for the Economics majors.

The findings here and in earlier studies (2, 3, 13) suggest that the constellations of attitudes and interests at the opposite poles of Factor I′ are basically antagonistic. That is, preferences for aesthetic activities and attitudes more often than not seem to be associated with disinterest in or dislike of the attitudes and interests of practical scientists, and vice versa.

2. *Factor II′.* There are a number of

surprises on the second factor. One might expect that men majoring in Economics and Political Science would be high scorers here, where high scores would be associated with preference for activities leading to the accumulation of wealth and power or prestige. The low scores of the English and Music majors would also be anticipated because of the probable disinterest in the materialistic values of the positive side of the factor and the probable interest in the artistic activities of the opposite pole of Factor II′. The tendency of aesthetic interests to be associated with tendencies toward maladjustment, which was noticeable to some extent on Factor I′ (see Table 3), is clearer on Factor II′.

The surprises are the high scores of the Psychology and Biochemistry majors and the low scores of the men majoring in Chemistry. The reasons which might account for the scores of the three subgroups are not readily apparent.

Greater psychological sophistication, which might lead to lower MMPI scores, and interest in the business-oriented aspects of their specialization field might be responsible for the high score of the Psychology majors.

The Biochemistry students may tend away from maladjustment as it is measured by the MMPI and may be significantly motivated by prestige factors and the promise of high income in selecting the premedical curriculum.

The Chemistry majors' position on the factor may be explained as arising in part from a strong rejection of the extraverted, "go-getting" activities of the positive side of Factor II′. However, such an explanation should apply with equal force to the Mathematics majors, who are

TABLE 8

SIGNIFICANT DIFFERENCES BETWEEN SUBGROUP MEAN SCORES ON FACTOR II′

Psych.	(.47)	− Engl.	(−.67) = 1.14
Econ.	(.37)	− Engl.	(−.67) = 1.04
Biochem.	(.25)	− Engl.	(−.67) = .92
Pol. Sci.	(.23)	− Engl.	(−.67) = .90
Psych.	(.47)	− Music	(−.31) = .78
Psych.	(.47)	− Chem.	(−.30) = .77
Math.	(.04)	− Engl.	(−.67) = .71

Note.—Numbers in parentheses are subgroup mean scores. $\sigma_{M_x - M_y} = .269$. Difference significant at .001 level = .89; difference significant at .01 level = .70.

TABLE 9

SIGNIFICANT DIFFERENCES BETWEEN SUBGROUP MEAN SCORES ON FACTOR III′

Music	(1.53)	− Hist.	(−.62) = 2.15
Music	(1.53)	− Pol. Sci.	(−.49) = 2.02
Music	(1.53)	− Biochem.	(−.38) = 1.91
Music	(1.53)	− Psych.	(−.36) = 1.89
Music	(1.53)	− Econ.	(−.24) = 1.77
Music	(1.53)	− Math.	(−.15) = 1.68
Music	(1.53)	− Chem.	(.04) = 1.49
Engl.	(.77)	− Hist.	(−.62) = 1.39
Engl.	(.77)	− Pol. Sci.	(−.49) = 1.26
Engl.	(.77)	− Biochem.	(−.38) = 1.15
Engl.	(.77)	− Psych.	(−.36) = 1.13
Engl.	(.77)	− Econ.	(−.24) = 1.01
Engl.	(.77)	− Math.	(−.15) = .92
Music	(1.53)	− Engl.	(.77) = .76
Engl.	(.77)	− Chem.	(.04) = .73

Note.—Numbers in parentheses are subgroup mean scores. $\sigma_{M_x - M_y} = .269$. Difference significant at .001 level = .89; difference significant at .01 level = .70.

some distance higher than the Chemistry majors on this factor. We must consider the possibility that the sample of Chemistry majors in this study is in some degree biased in the direction of maladjustment as measured by the MMPI. The Artistic and Aesthetic scales would not appear to offer any clues to the position of the Chemistry majors on Factor II′.

3. *Factor III′.* The students whose strongest preferences are probably in the aesthetic areas are found at the top of the Factor III′ scores. The absence of an essentially verbal scale (Literary, for example) and the presence of the Musical scale among the significant loadings on the plus side of the factor are probably responsible for the top position of the Music majors on this factor.

The placement of several other subgroups on Factor III′ is difficult to explain. One would have expected strong social service tendencies from the men majoring in Psychology and Biochemistry (Premedical). These preferences, combined with a probable disinterest in aesthetic pursuits, would have pointed to a probable low position on this factor for the Psychology and Biochemistry majors. However, it is the History and Political Science students who are the low scorers here, a result which is unexpected both because of their higher position on Factor I′, where aesthetic interests contributed toward high scores, and because social service interests weaker than those of the Psy-

chology and Biochemistry majors would have been anticipated.

The presence of the Religious scale on the negative side of the factor may be a clue to the position of some of the subgroups. There were indications on Factor II′ that prestige and material enhancement might have been part of the attraction which drew the Psychology and Biochemistry students to their respective specialization areas. Factor III′ negative implies a more altruistic motivation for helping people, which may account in part for the placement of the latter groups on this factor.

Another way in which the Religious scale might affect the position of the various subgroups could be that the Religious scale represents a type of thinking (mystical?) which is not characteristic of essentially science-oriented students such as the Psychology and Biochemistry majors.

Some amount of interest in social welfare, most probably in social movements or in social legislation, would generally be found among History and Political Science majors, but it would not seem to be strong enough to explain satisfactorily the high scores made by the two subgroups on Factor III′.

4. Factor IV′. The positive pole of Factor IV′ links interest in business contact activities with tendencies toward certain kinds of maladjustment. The MMPI component with the highest loading on the factor, the Hypomania scale, is said to contain many items which evoke positive responses from people "who are merely ambitious, vigorous and full of plans" (6, p. 21).

Most Economic and Political Science majors probably would enter business, law, or related fields. The characteristics commonly associated with people who enter those fields of work match closely those of the positive side of the factor. Top scores on this factor for the Economics and Political Science students are, therefore, in line with logical expectations.

The activities of the research scientist, who was depicted as a typical representative of the negative side of the factor, appropriately are most attractive to the Mathematics, Chemistry, and Biochemistry students, who might be expected to show little interest, if not outright dislike, for the activities of the opposite side of the factor.

The relatively high scores of the English and History majors may be explained as more a rejection of the activities and value of the negative side than a preference for those of the positive side. In the case of the English majors, their position on the factor may also be influenced by the presence of MMPI scales on the positive side of the factor, as in Factor II′, and, to a lesser extent, in Factor I′.

5. Factor VI′. The distribution of factor scores of the student groups on Factor VI′ accords with what might be anticipated on this factor. It would certainly not be surprising to find the Mathematics and Chemistry students high up on the side of the factor which represents preference for precise, controllable work of a quantitative nature, in opposition to interest in working with people in welfare activities.

The position of the Economic students is higher than one would have expected

TABLE 10

SIGNIFICANT DIFFERENCES BETWEEN SUBGROUP MEAN SCORES ON FACTOR IV′

Econ.	(1.16) − Biochem.	(−.94) = 2.10
Econ.	(1.16) − Math.	(−.92) = 2.08
Econ.	(1.16) − Chem.	(−.85) = 2.01
Econ.	(1.16) − Psych.	(−.15) = 1.31
Econ.	(1.16) − Music	(−.13) = 1.29
Pol. Sci.	(1.07) − Biochem.	(−.94) = 2.01
Pol. Sci.	(1.07) − Math.	(−.92) = 1.99
Pol. Sci.	(1.07) − Chem.	(−.85) = 1.92
Pol. Sci.	(1.07) − Psych.	(−.15) = 1.22
Pol. Sci.	(1.07) − Music	(−.13) = 1.20
Engl.	(.42) − Biochem.	(−.94) = 1.36
Engl.	(.42) − Math.	(−.92) = 1.34
Engl.	(.42) − Chem.	(−.85) = 1.27
Hist.	(.29) − Biochem.	(−.94) = 1.23
Hist.	(.29) − Math.	(−.92) = 1.21
Hist.	(.29) − Chem.	(−.85) = 1.14

Note.—Numbers in parentheses are subgroup mean scores: $\sigma_{M_0-M_0} = .339$. Difference significant at .001 level = 1.12; difference significant at .01 level = .88.

TABLE 11

SIGNIFICANT DIFFERENCES BETWEEN SUBGROUP MEAN SCORES ON FACTOR VI′

Math.	(.92) − Biochem.	(−.68) = 1.60
Math.	(.92) − Psych.	(−.66) = 1.58
Math.	(.92) − Music	(−.39) = 1.31
Math.	(.92) − Hist.	(−.15) = 1.07
Math.	(.92) − Engl.	(−.10) = 1.02
Econ.	(.62) − Biochem.	(−.68) = 1.30
Econ.	(.62) − Psych.	(−.66) = 1.28
Econ.	(.62) − Music	(−.39) = 1.01
Chem.	(.31) − Biochem.	(−.68) = .99
Chem.	(.31) − Psych.	(−.66) = .97
Pol. Sci.	(.19) − Biochem.	(−.68) = .87
Pol. Sci.	(.19) − Psych.	(−.66) = .85
Econ.	(.62) − Hist.	(−.15) = .77
Econ.	(.62) − Engl.	(−.10) = .72
Math.	(.92) − Pol. Sci.	(.19) = .73
Chem.	(.31) − Music	(−.39) = .70

Note.—Numbers in parentheses are subgroup mean scores. $\sigma_{M_x - M_y} = .269$. Difference significant at .001 level = .89; difference significant at .01 level = .70.

from the composition of the factor. The high mean Factor VI′ score of the Economics majors appears to be in part attributable to the fact that the activities represented by the components of the positive side of the factor are an integral part of almost all business. Another possible reason for the high score rises out of experience with Economics majors at the particular college where the study took place. There is usually a sizable group of accountants-to-be in every class of Economics majors. Accountants' interests and preferences would tally closely with those found at the positive pole of Factor VI′.

The Psychology and Biochemistry majors could be expected to be motivated by a desire to work with people in activities which could be categorized as "social service." An objection might be raised that quantitative work is involved in much of the training and in some of the work which these students will probably do after their training is completed. However, computational and clerical work would only be a small part of the daily routine of most doctors and psychologists. It is not a major, intrinsic element in their work, as it is in the work of the mathematician, the chemist, the comptroller, or the accountant.

The Music students' position probably does not reflect an interest in social service activities, but rather a strong disinterest in the activities of the positive side of the factor.

The scores of the remaining subgroups are found around the zero mark, which may be taken to mean that neither pole of the factor particularly draws or repels the students in these subgroups.

V. CONCLUSIONS

An inspection of Tables 7–11 will show that each subgroup differs from every other subgroup in mean scores on at least one factor by a margin which is significant at or beyond the 1 per cent level of confidence. In other words, each subgroup may be said to exhibit a pattern of traits which is different from the pattern characteristic of all other subgroups in the study population.

The sharpest differences are those which separate the "aesthetic" group (English and Music) from the "science" group (Chemistry, Mathematics, Biochemistry, and possibly Psychology). The subgroups in these two areas are those most often found at the top or the bottom of the distributions of factor scores on the various factors, and the two areas tend to be at opposite poles on most factors.

These last observations may be broadened into a general statement that the subgroups tend to form into *area* groups, which are more easily distinguishable from other area groups than most individual subgroups are from each other. The member subgroups of each area group tend to be more like each other

than like subgroups in other areas. Similarities and differences among area groups are summarized below:

English and Music: These subgroups are close together on Factors I′, II′, III′, IV′, and VI′. They show their strongest preferences in aesthetic activities. Tendencies toward maladjustment are more pronounced here than in any other area, particularly among the English majors. There is a noticeable interest in communicating with people, but it appears to have an ideational motivation rather than an interpersonal one, so that working with people to help them, which might be an avenue for interpersonal communication, does not seem to interest the English and Music majors. Activities having to do with business are rejected by these students, as are scientific activities and attitudes.

Chemistry and Mathematics: These two subgroups show similar tendencies on all factors. Scientific, mechanical, and quantitative activities or attitudes are valued most by the men specializing in these subjects. Their most pronounced aversions are for aesthetic, business contact, and social service activities. Direct communication with people does not seem to interest these students to any appreciable extent.

Biochemistry and Psychology: The "human science" subgroups are close together on Factors II′, III′, and VI′. Although they are significantly different from each other in mean factor scores on Factors I′ and IV′, they show tendencies in the same direction on the latter factors. The common bond between them is the merging of scientific attitudes with an interest in helping people. The Biochemistry majors are stronger in their scientific attitudes and interests, the Psychology students in their interests in contact activities. Both groups show a stronger interest in prestige and power than might have been expected, or than one might have hoped to find in men planning to go into professions where the primary motivation is supposed to be a desire to work with people to help them.

Economics, Political Science, and History: Similarities and differences seem to shift among this trio, so that two of the three subgroups are together on one factor, but then separated more or less widely on another. On Factor I′, Political Science and History are together, with scores which are significantly higher than those made by the Economics students. The predominance of materialistic attitudes in the latter subgroup may be the chief reason for the lower score on this factor where low scores mean disinterest in aesthetic activities and preference for activities with more possibilities for practical application. On Factor II′, the Economics and Political Science majors are close together, separated from the History students, although the difference in scores is not statistically significant. The contact activities of the Persuasive scale are probably more interesting to the Political Science and Economics majors than they are to the men majoring in History. The pairing changes again on Factor III′, where the History and Political Science students have similar scores, lower than those of the Economics majors, but not by a significant amount. The outcome on Factor III′ seems to reflect the weaker interest of the Economics subgroup in welfare activities. There is a shift in position again on Factor IV′, where the expected preference of the Political Science and Economics majors for contact activities places them significantly higher than the History students. On the next factor, VI′, the Economics subgroup's greater interest in business-related quantitative detail work explains their position with respect to the other "social science" subgroups.

Summing up the findings about intergroup differences in patterns of personality traits, it may be said that there are significant differences among groups of students specializing in the major fields of study represented in this investigation. The extent of the differences varies considerably from group to group of majors. The differences may be seen most clearly when students in different *areas* of study—humanities and fine arts, social sciences, "human sciences," and physical sciences and mathematics—are compared.

Do the data lend themselves to individual prediction of personality patterns of students majoring in different subject fields? A glance at the coefficients of multiple correlation and the standard error of estimate for each factor, which follow, shows that the answer must be "no."

	R	*SE*
Factor I′	.90	.42
Factor II′	.88	.47
Factor III′	.83	.54
Factor IV′	.80	.60
Factor VI′	.87	.50

A difference from a recorded factor score of the magnitude of even the smallest standard error of estimate would ma-

terially affect the factor-score position of many of the participants in the present investigation.

The *F* ratios and *t* ratios for factors scores are sufficiently large in the case of most of the factors to allow the inference that intergroup differences are not the result of chance influences. The results imply that an analysis of scores made by populations similar to the one in this study would give outcomes similar to those obtained in the study.

To some extent, the validity of the findings is supported by the relationships between the major fields of study and the patterns of traits here associated with each field. The trait patterns characterizing each field seem to be those which we could logically expect to find. That is, from our present knowledge of the needs represented by the different trait patterns and of the probability of satisfaction of those needs in the college majors (and related vocational fields) associated with the patterns, the relationships between trait patterns and majors appear to be logical.

There is no intent to imply that the patterns of traits which characterize the subgroups in this study are the "right" patterns for all students who might wish to specialize in the different major fields. Neither is it intended to imply that students in search of a field of specialization need be shrunk or stretched to fit the trait patterns found to be related to the nine major fields that were considered in this study. What is suggested is that knowledge of the trait pattern of a particular student can be helpful in clarifying the related needs of the student and can serve to provide *one* guide to help him choose the best field of study for himself.

The meaning of a pattern of test scores seems to be clearer when we can see the basic factors underlying the relationships among the scores. Although a careful analysis of the separate test scores may lead to some insight into the nature of the relationships, the factor analysis seems to give a much clearer and more precise picture of the patterns into which test scores fall and so make possible more accurate and more meaningful interpretations of scores on a battery of tests.

VI. Suggestions for Further Research

How are interests in particular areas of activity developed? What is the influence of specific cultural pressures in the formation of particular interests and attitudes? Does the opportunity for passive fantasy which is present in aesthetic interests tend to attract particular personality types? The answers to these questions might be sought in a longitudinal study, similar to that made by Ginzberg and his associates (4), but focused on the choice of *specific* educational and vocational goals, rather than on the *general* process of career choice.

An investigation of the factor patterns of personality traits of academically successful and unsuccessful students in different major fields of study might yield results useful for educational counseling. Tests could be administered to entering college students, whose academic progress could be charted throughout their stay in college.

Women college students might be studied in the same way as the population here was examined. Comparison of the factor compositions in the two studies might provide useful information about sex differences in nonintellectual factors as they relate to the choice of a field of specialization in college.

Factor patterns of college students in various regions of the United States might be compared to see if there are significant differences in regional patterns of personality traits. There is evidence of regional differences in raw scores on tests of interests, values and tendencies toward maladjustment.

VII. Summary

The purpose of this study was to determine the nature of patterns of certain measured personality traits and the extent of the differences in patterns among students majoring in different subjects in college. The emphasis in the study was on *patterns* of test scores because of the

increasing awareness of the importance of understanding relationships among test scores in the counseling of students. Nonstatistical formulations of test-score patterns are unprecise and unreliable, and point up the need for a more systematic approach to the discovery and interpretation of test-score patterns. The factor-analysis method, in which relationships among test scores may be ordered into relatively precise and stable patterns, seems to offer a better approach than other methods now in use.

The Kuder Preference Record, the Allport-Vernon Study of Values, and the MMPI were administered to 270 white, male students, 30 from each of nine fields of study. The data were factor analyzed by the Thurstone centroid method. Multiple regression equations were used to select predictor variables by which the raw scores of all subjects were converted into factor scores. The nine student subgroups were then compared on mean factor scores, by *F* and *t* tests.

Seven factors were extracted, all but one bipolar in structure. Only five of the factors were used to differentiate among the student groups. One factor, V′, was eliminated because its *F* ratio was too low. Another factor, VII′, was ambiguous in structure and appeared to have too little practical significance to warrant using it further in the study.

Every major subgroup differed significantly in mean factor scores from all other subgroups on at least one factor. *Areas* of study—aesthetics (English and Music), social science (History, Political Science, and Economics), "human science" (Psychology and Biochemistry or Premedical), and natural science and mathematics (Chemistry and Mathematics)—showed broader differences between them than were found between most individual fields of study.

Intergroup differences in mean factor scores were large enough to imply accuracy for group prediction, but were not large enough for individual prediction.

The intergroup differences were in accord with what might be termed "logical expectations," that is there appeared to be a logical relationship between a pattern characteristic of a particular major group and the need satisfactions which would probably be found in the study field or in related occupations.

The factor-analysis approach seemed to clarify patterns of relationships among test scores in a more definite fashion than appeared to be the case where observational techniques or rule-of-thumb approaches were used.

Some implications for personality theory are present in some factor compositions and in their relationships to specific fields of study.

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APPENDIX A

Facilitating Table for Factor I'

Factor Scores*	Raw Scores					
	Musical	Literary	Scientific	Economic	Mechanical	Theoretical
1.60			14			
1.56			15			
1.52			16			
1.48			17			
1.44			18–19			
1.40			20			
1.36			21			
1.32			22			
1.28			23–24			
1.24			25			
1.20			26	6		
1.16			27	7		
1.12			28–29	—		
1.08			30	8		
1.04			31	9		
1.00			32	—	1–2	
.96			33–34	10	3–4	
.92			35	11	5–7	
.88			36	—	8–9	
.84			37	12	10–12	
.80			38–39	13	13–14	
.76			40	14	15–16	
.72			41	—	17–19	0–1
.68			42	15	20–21	2
.64			43–44	16	22–24	3–4
.60			45	—	25–26	5–6
.56			46	17	27–28	7–8
.52			47	18	29–31	9–10
.48			48	—	32–33	11–12
.44	54–56		49–50	19	34–36	13
.40	52–53		51	20	37–38	14–15
.36	49–51		52	21	39–40	16–17
.32	46–48		53	—	41–43	18–19
.28	44–45		54–55	22	44–45	20–21
.24	41–43		56	23	46–48	22–23
.20	38–40	104–112	57	—	49–50	24
.16	35–37	94–103	58	24	51–52	25–26
.12	33–34	85–93	59–60	25	53–55	27–28
.08	30–32	76–84	61	—	56–57	29–30
.04	27–29	67–75	62	26	58–60	31–32
.00	24–26	57–66	63	27	61–62	33–34

* In standard score units.

APPENDIX A (*Continued*)

Factor Scores*	Raw Scores					
	Musical	Literary	Scientific	Economic	Mechanical	Theoretical
− .04	22–23	48–56	64–65	28	63–64	35
− .08	19–21	39–47	66	—	65–67	36–37
− .12	16–18	29–38	67	29	68–69	38–39
− .16	13–15	20–28	68	30	70–72	40–41
− .20	11–12	11–19	69–70	—	73–74	42–43
− .24	8–10	2–10	71	31	75–76	44–45
− .28	5–7		72	32	77–79	46–47
− .32	2–4		73	—	80–81	48
− .36	0–1		74–75	33	82–84	49–50
− .40			76	34	85–86	51–52
− .44			77	35	87–88	53–54
− .48			78	—	89–91	55–56
− .52			79–80	36	92–93	57–58
− .56			81	37	94–96	59
− .60			82	—	97–98	60
− .64			83	38	99–100	
− .68			84	39	101–103	
− .72			85–86	—	104–105	
− .76			87	40	106–108	
− .80			88	41	109–110	
− .84			89	42	111–112	
− .88			90–91	—	113–115	
− .92			92	43	116–117	
− .96			93	44	118–120	
−1.00			94	—	121–122	
−1.04			95–96	45		
−1.08			97	46		
−1.12			98	—		
−1.16			99	47		
−1.20			100–101	48		
−1.24			102			
−1.28			103			
−1.32			104			
−1.36			105–106			
−1.40			107			
−1.44			108			
−1.48			109			
−1.52			110–111			
−1.56			112			
−1.60			113			

APPENDIX B

SAMPLE CONVERSION SHEET

Scale	Raw Score	I′	II′	III′	IV′	V′	VI′	
Theo.	32	.04			.12		.04	Factor Scores
Econ.	14	.76			−1.20	−.24		I 1.56
Aes.	33			.24				II − .80
Soc.	33					−.04	− .08	III .52
Pol.	27							IV −1.00
Rel.	41							V − .40
Mech.	47	.24			.20			VI − .96
Comp.	22						− .28	
Sci.	52	.36						
Per.	56		−.40		− .32			
Art.	63			.16				
Lit.	91	.12						
Mus.	29	.04		.08				
Soc.-Ser.	85			−.20			− .12	
Cler.	28			.20			− .52	
Hs	13				.04			
D	18		.08					
Hy	23				.20			
Pd	23						.00	
Mf	37		−.28		− .36			
Pa	09		.00	.04				
Pt	27		.04					
Sc	32		−.24		.48			
Ma	16				− .28			
Totals		1.56	.12	.72	.80	.24	.04	
			−.92	−.20	−1.80	−.64	−1.00	
			−.80	.52	−1.00	−.40	− .96	